

CLAIMS

What is claimed is:

- 5 1. A method for dynamic ingress to egress tunnel mapping on a communication network, the method comprising:
- receiving a tunneled communication from a subscriber using said first communication network, said first communication network connected to at least one communication network by at least one egress tunnel;
- 10 determining egress tunnel selection criteria for said tunneled communication, said egress tunnel selection criteria indicating the basis for selecting one of said at least one egress tunnel;
- selecting one of said at least one egress tunnel based on said egress tunnel selection criteria; and
- 15 forwarding said tunneled communication on the selected egress tunnel.
2. The method of claim 1, further comprising initializing a tunnel database that includes tunnel selection criteria for at least one egress tunnel connecting said first communication network to said at least one communication network.
- 20 3. The method of claim 1 wherein said tunneled communication comprises a Point-to-Point Protocol (PPP) session.
4. The method of claim 3 wherein said tunnels comprise L2TP tunnels.
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5. The method of claim 4 wherein said selecting further comprises:

determining an ingress tunnel ID for said tunneled session, said ingress tunnel ID

uniquely identifying an ingress tunnel including said PPP session; and

- 5 selecting one of said one or more available egress tunnels based on said ingress tunnel ID.

6. The method of claim 4 wherein said selecting further comprises:

determining a subscriber domain for said tunneled session; and

- 10 selecting one of said one or more available egress tunnels based on said subscriber domain.

7. The method of claim 4 wherein said selecting further comprises:

examining Type of Service (ToS) bits associated with said PPP session; and

- 15 selecting one of said one or more available egress tunnel based on said ToS bits.

8. The method of claim 4 wherein said selecting further comprises:

examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair

associated with said PPP session; and

- 20 selecting one of said one or more available egress tunnel based on said VPI/VCI pair.

9. The method of claim 4 wherein said selecting further comprises randomly selecting

one of said one or more available egress tunnel connected to said remote domain.

10. The method of claim 4 wherein said selecting further comprises:

determining the available bandwidth for at least one egress tunnel to said remote

domain; and

5 selecting one of said one or more available egress tunnel to said remote domain

having the most available bandwidth.

11. The method of claim 4 wherein said selecting further comprises:

determining a time at which said PPP session is received; and

10 selecting one of said one or more available egress tunnel based on said time.

12. The method of claim 4 wherein said selecting further comprises:

determining the time at which said PPP session is received;

determining the available bandwidth for at least one egress tunnel to said remote

15 domain; and

selecting one of said one or more available egress tunnel having the most available

bandwidth at said time.

13. The method of claim 4 wherein said selecting further comprises:

20 examining Type of Service (ToS) bits associated with said PPP session;

determining the available bandwidth for at least one egress tunnel to said remote

domain; and

selecting one of said one or more available egress tunnel based on said ToS bits and

said available bandwidth.

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14. The method of claim 4 wherein said selecting further comprises:

examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair

associated with said PPP session;

5 determining a class of service based on said VPI/VCI pair;

determining the available bandwidth for at least one egress tunnel to said remote

domain; and

selecting one of said one or more available egress tunnel based on said class of

service and said available bandwidth.

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15. The method of claim 4 wherein said selecting further comprises selecting one of said

one or more available egress tunnel to said remote domain having the smallest

number of tunneled sessions such that tunneled sessions are distributed evenly among

egress tunnels to said remote domain.

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16. A program storage device readable by a machine, embodying a program of

instructions executable by the machine to perform a method to dynamically map

ingress to egress tunnels on a communication network, the method comprising:

20 receiving a tunneled communication from a subscriber using said first communication

network, said first communication network connected to at least one

communication network by at least one egress tunnel;

determining egress tunnel selection criteria for said tunneled communication, said

egress tunnel selection criteria indicating the basis for selecting one of said at

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least one egress tunnel;

selecting one of said at least one egress tunnel based on said egress tunnel selection criteria; and
forwarding said tunneled communication on the selected egress tunnel.

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17. The program storage device of claim 16 wherein said method further comprises initializing a tunnel database that includes tunnel selection criteria for at least one egress tunnel connecting said first communication network to said at least one communication network.

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18. The program storage device of claim 16 wherein said tunneled communication comprises a Point-to-Point Protocol (PPP) session.

19. The program storage device of claim 18 wherein said tunnels comprise L2TP tunnels.

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20. The program storage device of claim 19 wherein said selecting further comprises:
determining an ingress tunnel ID for said tunneled session, said ingress tunnel ID uniquely identifying an ingress tunnel including said PPP session; and
selecting one of said one or more available egress tunnels based on said ingress tunnel ID.

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21. The program storage device of claim 19 wherein said selecting further comprises:
determining a subscriber domain for said tunneled session; and
selecting one of said one or more available egress tunnels based on said subscriber domain.

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22. The program storage device of claim 19 wherein said selecting further comprises:

examining Type of Service (ToS) bits associated with said PPP session; and

selecting one of said one or more available egress tunnel based on said ToS bits.

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23. The program storage device of claim 19 wherein said selecting further comprises:

examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair

associated with said PPP session; and

selecting one of said one or more available egress tunnel based on said VPI/VCI pair.

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24. The program storage device of claim 19 wherein said selecting further comprises

randomly selecting one of said one or more available egress tunnel connected to said

remote domain.

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25. The program storage device of claim 19 wherein said selecting further comprises:

determining the available bandwidth for at least one egress tunnel to said remote

domain; and

selecting one of said one or more available egress tunnel to said remote domain

having the most available bandwidth.

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26. The program storage device of claim 19 wherein said selecting further comprises:

determining a time at which said PPP session is received; and

selecting one of said one or more available egress tunnel based on said time.

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27. The program storage device of claim 19 wherein said selecting further comprises:

determining the time at which said PPP session is received;

determining the available bandwidth for at least one egress tunnel to said remote domain; and
selecting one of said one or more available egress tunnel having the most available bandwidth at said time.

28. The program storage device of claim 19 wherein said selecting further comprises:

examining Type of Service (ToS) bits associated with said PPP session;
determining the available bandwidth for at least one egress tunnel to said remote domain; and
selecting one of said one or more available egress tunnel based on said ToS bits and said available bandwidth.

29. The program storage device of claim 19 wherein said selecting further comprises:

examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair associated with said PPP session;
determining a class of service based on said VPI/VCI pair;
determining the available bandwidth for at least one egress tunnel to said remote domain; and
selecting one of said one or more available egress tunnel based on said class of service and said available bandwidth.

30. The program storage device of claim 19 wherein said selecting further comprises

selecting one of said one or more available egress tunnel to said remote domain

having the smallest number of tunneled sessions such that tunneled sessions are distributed evenly among egress tunnels to said remote domain.

- 5 31. An apparatus for dynamic ingress to egress tunnel mapping on a communication network, the apparatus comprising:
- means for receiving a tunneled communication from a subscriber using said first communication network, said first communication network connected to at least one communication network by at least one egress tunnel;
- 10 means for determining egress tunnel selection criteria for said tunneled communication, said egress tunnel selection criteria indicating the basis for selecting one of said at least one egress tunnel;
- means for selecting one of said at least one egress tunnel based on said egress tunnel selection criteria; and
- 15 means for forwarding said tunneled communication on the selected egress tunnel.
32. The apparatus of claim 31, further comprising means for initializing a tunnel database that includes tunnel selection criteria for at least one egress tunnel connecting said first communication network to said at least one communication network.
- 20 33. The apparatus of claim 31 wherein said tunneled communication comprises a Point-to-Point Protocol (PPP) session.
34. The apparatus of claim 33 wherein said tunnels comprise L2TP tunnels.
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35. The apparatus of claim 34 wherein said means for selecting further comprises:

means for determining an ingress tunnel ID for said tunneled session, said ingress
tunnel ID uniquely identifying an ingress tunnel including said PPP session; and

5 means for selecting one of said one or more available egress tunnels based on said
ingress tunnel ID.

36. The apparatus of claim 34 wherein said means for selecting further comprises:

means for determining a subscriber domain for said tunneled session; and

10 means for selecting one of said one or more available egress tunnels based on said
subscriber domain.

37. The apparatus of claim 34 wherein said means for selecting further comprises:

means for examining Type of Service (ToS) bits associated with said PPP session;

15 and

means for selecting one of said one or more available egress tunnel based on said ToS
bits.

38. The apparatus of claim 34 wherein said means for selecting further comprises:

20 means for examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier
(VCI) pair associated with said PPP session; and

means for selecting one of said one or more available egress tunnel based on said
VPI/VCI pair.

39. The apparatus of claim 34 wherein said means for selecting further comprises means for randomly selecting one of said one or more available egress tunnel connected to said remote domain.

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40. The apparatus of claim 34 wherein said means for selecting further comprises:
means for determining the available bandwidth for at least one egress tunnel to said remote domain; and
means for selecting one of said one or more available egress tunnel to said remote
10 domain having the most available bandwidth.

41. The apparatus of claim 34 wherein said means for selecting further comprises:
means for determining a time at which said PPP session is received; and
means for selecting one of said one or more available egress tunnel based on said
15 time.

42. The apparatus of claim 34 wherein said means for selecting further comprises:
means for determining the time at which said PPP session is received;
means for determining the available bandwidth for at least one egress tunnel to said
20 remote domain; and
means for selecting one of said one or more available egress tunnel having the most available bandwidth at said time.

43. The apparatus of claim 34 wherein said means for selecting further comprises:
25 means for examining Type of Service (ToS) bits associated with said PPP session;

means for determining the available bandwidth for at least one egress tunnel to said

remote domain; and

means for selecting one of said one or more available egress tunnel based on said ToS

5 bits and said available bandwidth.

44. The apparatus of claim 34 wherein said means for selecting further comprises:

means for examining a Virtual Path Identifier (VPI) / Virtual Channel Identifier

(VCI) pair associated with said PPP session;

10 means for determining a class of service based on said VPI/VCI pair;

means for determining the available bandwidth for at least one egress tunnel to said

remote domain; and

means for selecting one of said one or more available egress tunnel based on said

class of service and said available bandwidth.

15 45. The apparatus of claim 34 wherein said means for selecting further comprises means

for selecting one of said one or more available egress tunnel to said remote domain

having the smallest number of tunneled sessions such that tunneled sessions are

distributed evenly among egress tunnels to said remote domain.

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46. An apparatus for dynamic ingress to egress tunnel mapping on a communication network, the apparatus comprising:

a receiving interface to receive a tunneled communication from a subscriber using

5 said first communication network, said first communication network connected to at least one communication network by at least one egress tunnel;

an egress tunnel selection criteria determiner to determine egress tunnel selection criteria for said tunneled communication, said egress tunnel selection criteria indicating the basis for selecting one of said at least one egress tunnel;

10 an egress tunnel selector to select one of said at least one egress tunnel based on said egress tunnel selection criteria; and

a session forwarder to forward said tunneled communication on the selected egress tunnel.

15 47. The apparatus of claim 46, further comprising a tunnel database initializer to initialize a tunnel database that includes tunnel selection criteria for said at least one egress tunnel connecting said first communication network to said at least one communication network.

20 48. The apparatus of claim 46 wherein said tunneled communication comprises a Point-to-Point Protocol (PPP) session.

49. The apparatus of claim 48 wherein said tunnels comprise L2TP tunnels.

50. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnels based on an ingress tunnel ID.

5 51. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnels based on a subscriber domain for said tunneled session.

10 52. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel based on ToS bits associated with said PPP session.

15 53. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel based on a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair associated with said PPP session.

20 54. The apparatus of claim 49 wherein said egress tunnel selector is further configured to randomly select one of said one or more available egress tunnel connected to said remote domain.

25 55. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel to said remote domain having the most available bandwidth.

56. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel based on a time at which said PPP session is received.

57. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel having the most available bandwidth at a time at which said PPP session is received.

58. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel based upon ToS bits associated with said PPP session and upon the available bandwidth for at least one egress tunnel to said remote domain.

59. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel based on a Virtual Path Identifier (VPI) / Virtual Channel Identifier (VCI) pair and upon the available bandwidth for at least one egress tunnel to said remote domain.

60. The apparatus of claim 49 wherein said egress tunnel selector is further configured to select one of said one or more available egress tunnel to said remote domain having the smallest number of tunneled sessions such that tunneled sessions are distributed evenly among egress tunnels to said remote domain.

61. The apparatus of claim 49, further comprising:

a monitor to periodically assess the loading of said apparatus; and

a notifier to indicate that ingress tunnels should be directed to a different apparatus

5 when said loading exceeds a predetermined threshold.